

REMARKS

Applicants thank the Examiner for the very thorough consideration given the present application. Claims 1-6 are currently pending in this application. No new matter has been added by way of the present amendment. For instance, the amendments to claims 1 and 2 are supported by Figure 4. Accordingly, no new matter has been added.

At the outset, the present application is believed to be in condition for allowance. Entry of the accompanying amendment is requested under 37 C.F.R. §1.116, as the amendment does not raise any new issues which would require further search and/or consideration by the Examiner. Furthermore, Applicants request entry of this amendment in order to place the claims in better form for consideration on Appeal.

In view of the amendments and remarks herein, Applicants respectfully request that the Examiner withdraw all outstanding rejections and allow the currently pending claims.

Issues Under 35 U.S.C. § 102(b)

Claims 1-3 and 5 stand rejected under 35 U.S.C. 102(b) as being anticipated by Kashima et al. (JP 07-86162) (hereinafter Kashima '162). Applicants respectfully traverse.

The Examiner reaffirms his previous position that Kashima '162 discloses a method of forming a heterostructure film comprising supplying a group IIIa and Va material to grow a IIIaVa thin film using gas source molecular beam epitaxy. The Examiner further asserts that Kashima '162 discloses suspending the supply of the Va group material and further discloses "a time discontinuation of the supply of all thin film raw materials to a substrate," in order to terminate growth of the IIIaVa thin film. Additionally, the Examiner asserts that "Kashima et al. teaches a

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time period t_2 where all raw materials are suspended which reads on reducing a supply of the first group V element to 0...Kashima et al teaches closing the shutter to the molecular source beam which would result in 0 irradiation from the source cell."

Applicants respectfully submit that the Examiner has failed to establish a *prima facie* case of anticipation. For anticipation under 35 U.S.C. §102, the reference must teach each and every aspect of the claimed invention either explicitly or impliedly. Any feature not directly taught must be inherently present. The fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic. *In re Rijckaert*, 9 F.3d 1531, 28 USPQ2d 1955 (Fed. Cir. 1993). To establish inherency, the extrinsic evidence "must make clear that the missing descriptive matter is necessarily present". *In re Robertson*, 169 F.3d 743, 49 USPQ2d 1949 (Fed. Cir. 1999). The mere fact that a certain thing may result from a given set of circumstances is not sufficient. *Id.*

The present invention is directed, *inter alia*, to an epitaxial growth method to form a semiconductor thin film including a heterojunction of a group III-V compound semiconductor by means of molecular beam epitaxy. Present claim 1 requires a first step of irradiating a molecular beam of at least one of group III elements and a molecular beam of a first group V element to form a first compound semiconductor layer, a second step of stopping the irradiation of the molecular beam of the group III element and the molecular beam of the first group V element and halting growth for a period of time until the remaining molecular beam intensity of the first group V element is reduced to 1/10 to 1/100 of that in the first step, and a third step of irradiating a molecular beam of at least one of the group III elements and a molecular beam of a second group V element to form an etch stopper layer on the first compound semiconductor layer.

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Similarly, present claim 2 requires first and third steps as above, and further requires a second step of stopping the irradiation of the molecular beam of the group III element and the molecular beam of the first group V element and irradiating a molecular beam of a second group V element and halting growth for a period of time until the remaining molecular beam intensity of the first group V element is reduced to 1/10 to 1/100 of that in the first step. Applicants submit that the prior art of record fails to explicitly or implicitly disclose a method as claimed.

Kashima '162 discloses an epitaxial growth method comprising: supplying a group III element and a first group V element ("Va") to form a first semiconductor layer; suspending the supply of the "Va" element temporarily; and, supplying a second group V element ("Vb"). The Examiner appears to interpret the presently claimed "second step" (see claims 1 and 2) as merely requiring discontinuation of the supply of element Va. However, Applicants submit that the Examiner's position is based on a misunderstanding of the present claims.

The Examiner suggests that the time period t2 disclosed by Kashima '162 is equivalent to the presently claimed second step, in that the supply of the first group V element is reduced to 0 in both cases. However, Applicants submit that Kashima '162 fails to teach or suggest a step of "halting growth for a period of time until the **remaining** molecular beam intensity of the first group V element is reduced to 1/10 or less of that in the first step" (emphasis added), as presently claimed.

Kashima '162 discloses that the time t2 lasts until the excess group V element is detached from the substrate surface and the coverage thereof becomes 1 (1 molecular layer) ([0006]). In addition, Kashima '162 discloses that t2 is approximately 24 seconds (see Fig. 2, for example).

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In stark contrast, the present second step lasts no more than one second (see page 9, line 24 to page 10, line 1 of the Specification; see also Fig. 4).

The present inventors have discovered that, by controlling the amount of the group V element remaining during epitaxial growth by MBE, it is possible to form a heterointerface with stable properties, and an etch stopper layer with high selectivity (see page 11, lines 20-23 of the Specification).

The etching resistance of the etch stopper layer comprising the second compound semiconductor layer depends on the amount of the first group V element mixed. Figure 3 shows that, when the mixed amount is less than 0.05, the etching rate is less than 0.10 nm/sec. Thus, the present inventors have developed an etch stopper layer with high selectivity. However, in order to keep the amount of As mixed at less than 0.05 in the composition, it is necessary to start the growth of the InP etch stopper layer after the intensity of the As molecular beam is reduced to 1/10 or less (see page 10, lines 14-25 of the Specification). Reducing the intensity of the As molecular beam to 1/10 or less is a recited limitation. As a result of the claimed invention, unexpected and superior results are obtained (i.e., an etch stopper layer with high selectivity).

Evidently, Kashima '162 does not teach a step of stopping the irradiation to halt growth until the remaining molecular beam intensity of the first group V element is reduced to 1/10 to 1/100 of that in the first step. Accordingly, Kashima '162 cannot possibly anticipate the present invention.

Reconsideration and withdrawal of this rejection are thus respectfully requested.

Issues Under 35 U.S.C. § 103(a)

Claims 4 and 6 stand rejected under 35 U.S.C. 103(a) as being obvious over Kashima '162 in view of Watanabe (U.S. 6,229,162) (hereinafter Watanabe '162). Applicants respectfully traverse.

The Examiner admits that Kashima '162 does not teach a first layer of InP or InGaP and a second layer of InAlAs or InGaAs. The Examiner, however, relies on the teachings of Watanabe '162 to overcome this deficiency.

Applicants respectfully submit that the Examiner has failed to establish a *prima facie* case of obviousness. To establish a *prima facie* case of obviousness, the prior art reference (or references when combined) must teach or suggest all the claim limitations. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Additionally, there must be a reason why one of ordinary skill in the art would modify the reference or combine reference teachings to obtain the invention. A patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art. *KSR Int'l Co. v Teleflex Inc.*, 82 USPQ2d 1385 (U.S. 2007). There must be a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does. *Id.* The Supreme Court of the United States has recently held that the "teaching, suggestion, motivation test" is a valid test for obviousness, albeit one which cannot be too rigidly applied. *Id.* Rejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. *Id.*

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As discussed above, Kashima '162 fails to teach an epitaxial growth method comprising a step of stopping the irradiation of the molecular beam of a group III element and the molecular beam of a first group V element and halting growth for a period of time until the remaining molecular beam intensity of the first group V element is reduced to 1/10 to 1/100 of that in a previous step. Watanabe '162 fails to cure this deficiency.

Watanabe '162 is directed to a high-speed, high-sensitivity planar-type avalanche photodiode. However, Watanabe '162 does not teach or suggest an epitaxial growth method as presently claimed, wherein irradiation of the molecular beam of a group III element and the molecular beam of a first group V element are stopped, and growth is halted for a period of time until the remaining molecular beam intensity of the first group V element is reduced to 1/10 to 1/100 of that in a previous step in the process.

Evidently, the cited references, alone or in combination, fail to teach or suggest every limitation of the instant invention. Accordingly, reconsideration and withdrawal of this rejection are respectfully requested.

Conclusion


All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding rejections and objections and that they be withdrawn. It is believed that a full and complete response has been made to the outstanding Office Action and, as such, the present application is in condition for allowance.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Vanessa Perez-Ramos, Reg. No. 61,158, at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.17; particularly, extension of time fees.

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Respectfully submitted,

By 

Marc S. Weiner

Registration No.: 32,181

BIRCH, STEWART, KOLASCH & BIRCH, LLP

8110 Gatehouse Road

Suite 100 East

P.O. Box 747

Falls Church, Virginia 22040-0747

(703) 205-8000

Attorney for Applicant